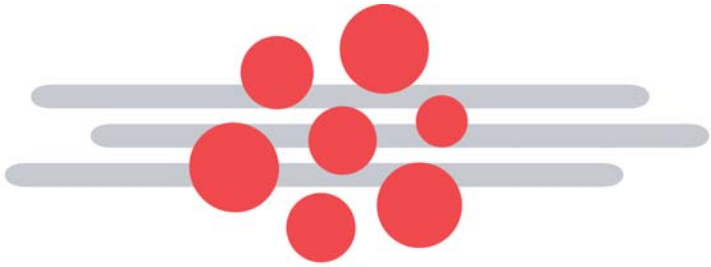
Project Execution Plan



Center for Functional Nanomaterials
Brookhaven National Laboratory

Project No. 05-R-321
May 2004
Revision 2

BNL Center for Functional Nanomaterials

Basic Energy Sciences

BROOKHAVEN NATIONAL LABORATORY BROOKHAVEN SCIENCE ASSOCIATES

Project Execution Plan (PEP)
for the
Center for Functional Nanomaterials (CFN)

At

Brookhaven National Laboratory (BNL)
Upton, New York

Submitted by:

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May 2004

BROOKHAVEN NATIONAL LABORATORY

Center for Functional Nanomaterials
Brookhaven National Laboratory

Project Execution Plan Change Log

Revision No.	Date	Reason
0	July 2003	Preliminary PEP
1	December 2003	Finalized PEP for EIR
2	May 2004	Baseline PEP for CD-2

Table of Contents

Glossary of Document Acronyms and Abbreviations

A/E	Architect/Engineer
AHA	Activity Hazard Analysis
ADA	Americans with Disabilities Act
BAO	Brookhaven Area Office
BCP	Baseline Change Proposal
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
CD	Critical Decision
CDR	Conceptual Design Report
CEGPA	Community, Education, Government and Public Affairs
CFR	Code of Federal Regulations
CFN	Center for Functional Nanomaterials
CR	Construction Field Representative
DEC	Department of Environmental Conservation
DOE	Department of Energy
EAC	Estimate at Completion
ECS	Engineering and Construction Services
ECSM	Engineering and Construction Services Manager
ES&H	Environment Safety & Health
ECN	Engineering Change Notice
EIR	External Independent Review
EMCS	Energy Management Control System
EPA	Environmental Protection Agency
FPSC	Fixed Price Construction Subcontractor
FPD	Federal Project Director
FY	Fiscal Year
GFP	Government Furnished Property
GPP	General Plant Project
GSA	General Services Administration
HASP	Health and Safety Plan
HQ	Headquarters
HVAC	Heating Ventilation and Air Conditioning
IPR	Independent Project Review
IPT	Integrated Project Team

ISM	Integrated Safety Management
LCC	Life Cycle Costs
LEED	Leadership in Energy and Environmental Design
M	Million
M&O	Management & Operations
NEPA	National Environmental Policy Act
NTP	Notice to Proceed
O&M	Operations and Maintenance
OMB	Office of Management and Budget
ORE	Operational Readiness Evaluation
PARS	Project Assessment and Reporting System
PBMC	Performance Based Management Contract
PDS	Project Data Sheet
PED	Project Engineering & Design
PEP	Project Execution Plan
PM	Project Manager
PQAP	Project Quality Assurance Program
QA	Quality Assurance
QAP	Quality Assurance Program
QC	Quality Control
QMS	Quality Management System
Rep	Representative
SAE	Secretarial Acquisition Executive
SBMS	Standards-Based Management System
SC	DOE Office of Science
SF	Square Foot
SLI	Science Laboratory Infrastructure
SOP	Standard Operating Procedure
TEC	Total Estimated Cost
TPC	Total Project Cost
USGBC	US Green Building Council
WBS	Work Breakdown Structure

1. INTRODUCTION

The purpose of this document is to identify and summarize the plans, organization and systems used to manage the Center for Functional Nanomaterials (CFN) Project from project planning through project completion.

Adherence to the plans described herein will allow all individuals involved with the project to understand their roles and responsibilities required to achieve the project objectives. Furthermore, implementation of the Project Execution Plan (PEP) will provide the oversight, feedback and controls required to determine progress toward schedule, quality, cost and performance goals and apply timely corrective action when necessary. The PEP is developed using an integrated systematic approach to ensure a project management system and effective management practices.

The project will be designed to the latest edition of codes, orders, standards, guides and in accordance with DOE Manual 413.3-1, "Project Management for the Acquisition of Capital Assets". An Integrated Project Team (IPT) consisting of DOE, BNL and contractor staff will execute the project. The IPT will be lead by the Federal Project Director with matrix support as detailed in Section 4, Management Roles and Responsibilities.

2. MISSION NEED

The CFN, one of several Department of Energy Nanoscale Science Research Centers (NSRCs), will serve as the nucleus of an integrated BNL program in nanoscience. It will facilitate major new directions in BNL's materials and chemical research programs, and greatly expand the capabilities available to a national user base, thereby increasing our university and industrial interactions. It will also enable BNL to promote complementary and interdisciplinary research in the various Departments including Biology, Chemistry, Materials Science, Condensed Matter Physics, Instrumentation Division, and the National Synchrotron Light Source. The CFN will also integrate BNL's unique capabilities in a broad range of synchrotron techniques, including hard and soft x-ray scattering and spectroscopy, with new materials synthesis and nanofabrication capabilities at BNL. The CFN will serve as a focal point for collaborations, enabling studies of functional materials at the nanoscale involving academia and private industry, particularly in the Northeast, thereby catalyzing a new approach to materials research at BNL.

An overriding need for the CFN is to provide an organizational infrastructure open to external users based on peer reviews that will enable and promote a truly national

nanomaterials effort, thereby creating breakthrough opportunities. The NSRCs also provide a long-term commitment to the solution of significant research problems and to the development of a new generation of researchers equipped to explore the properties of science and technology at the nanoscale.

3. PROJECT DESCRIPTION

The project scope includes the design and construction of a laboratory building and the acquisition of the requisite instrumentation to support the nanoscience thrust areas and laboratory functions that are identified in Section 2, Technical Facilities of the CDR.

The CFN facility will be a two-story building of approximately 94,500 square feet, housing clean rooms, wet and dry laboratories, office space for CFN staff and users, and conference rooms. The building will incorporate human factors into its design so as to encourage peer interactions and collaborative visits between BNL staff and users. In addition to offices and laboratories, it will house “interaction areas” for informal discussions and lunch rooms on each floor to foster scientific discourse. This design approach is commonly regarded as the state-of-the-art in research facility design. Material and system selections will address the principles of sustainable design to insure low energy and maintenance costs over the life of the building. Design features will be incorporated into the building design that account for the sensitivity of nanoscience instrumentation, i.e., vibration isolation, temperature controls as precise as +/- 0.1 C degrees and shielding from electromagnetic interference.

The CFN will operate through major laboratory clusters: including facilities for nanopatterning fabrication, ultrafast optical sources, electron microscopy, materials synthesis, proximal probes surface characterization, theory and computation, and an endstation at an NSLS beamline optimized for nanoscale characterization using small angle scattering. An initial set of scientific equipment for these laboratories will be purchased as part of the project. The NSLS provides a wide range of imaging, spectroscopy, and diffraction/scattering techniques. In order to take advantage of these features, including the NSLS endstation, the CFN Users will have access to a suite of existing beamlines at the NSLS including: soft x-ray microscopy beamlines; UV, soft and hard x-ray spectroscopy beamlines; soft and hard x-ray scattering beamlines; an infrared spectro-microscopy beamline; an undulator insertion device microprobe beamline; and an undulator insertion device nanoprobe beamline.

The BNL Center for Functional Nanomaterials will be a new building, located across the street from the existing NSLS to complement the existing functions of that facility. Siting of the CFN will take advantage of proximity to the Instrumentation Division (Building 535), and the Departments of Physics (Building 510), Materials Science (Building 480), and NSLS (Building 725), which are key interdisciplinary participants in nanoscience research.

The project will include the extension of existing site utilities to the new building including storm sewer, sanitary sewer, chilled water, potable water, fire protection systems, telephone, gas, steam, electric and communication services.

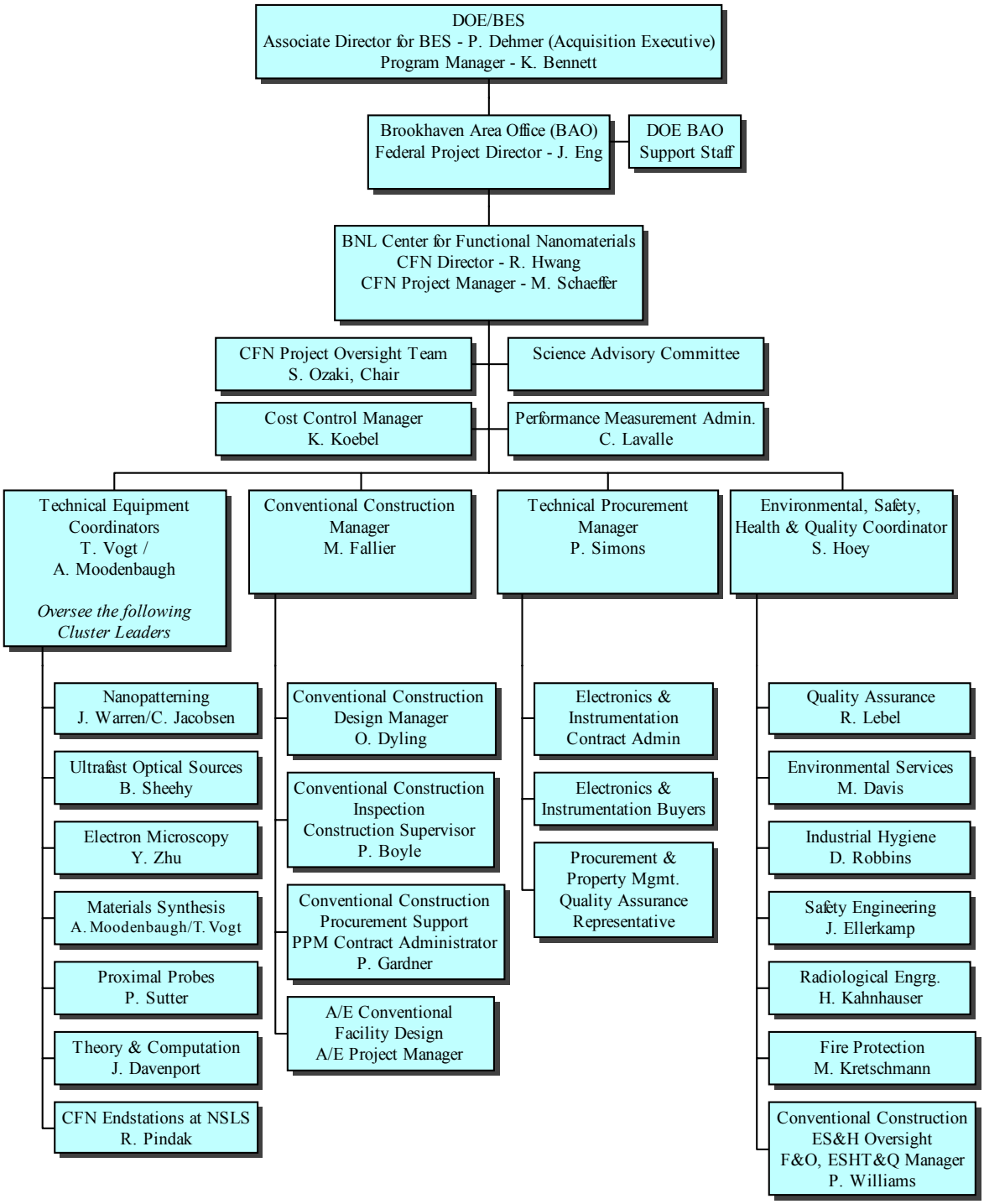
The CFN will integrate existing BNL capabilities including in its synchrotron characterization techniques, its Laser-Electron Accelerator Facility (LEAF) electron source, and its growing electron imaging facilities with new materials synthesis, imaging, materials temporal probes, and nanofabrication capabilities. The CFN will draw on the experience and infrastructure of the existing NSLS User Program, which handles more than 2500 users per year, to establish an active CFN User Program, including both individual and cooperative ventures. At full capacity, we estimate that 300-500 users will work at the CFN each year.

4. ORGANIZATIONAL STRUCTURE

A. Within SC, the Office of Basic Energy Sciences (SC-10) is the DOE/HQ organization having programmatic responsibility for the CFN project, and the Associate Director for Basic Energy Sciences is the Acquisition Executive (AE). The Construction Management Support Division (SC-81) advises the AE on project issues.

B. The Brookhaven Area Office (BAO), and BNL have implemented an integrated team approach to managing the CFN Project. The membership of the CFN Integrated Project Team is shown in Figure 1. The CFN Director leads the Project Management Team (PMT). The CFN Project Manager is the Chair of the Baseline Change Control Board. Lines of authority within this team are shown in Figure 1.

Figure 1
Center for Functional Nanomaterials (CFN)
Project Organization



C. The following roles and responsibilities address DOE actions that deal with the overall management decision-making for the approval, authorization, and change control of the CFN project. In addition to these responsibilities, there are requirements for the development, review and recommendation, approval of deliverables during the CFN project. These are described in Figure 4, CFN Authorities Matrix.

Authority and responsibility for managing the DOE programs and facilities resides with the Secretary of Energy. The Office of Science (SC) has been delegated responsibility for comprehensive, long range, basic energy-related research, including state-of-the-art research facilities, crucial to achieving goals described in the National Energy Strategy and the Department's Strategic Plan. SC provides overall program policy and guidance, technical oversight, and budgets for implementing its assigned role. Specific responsibility for design, construction, and operation of the CFN is assigned to SC's Office of Basic Energy Sciences (BES) (SC-10).

D. Acquisition Executive (SC-10)

As the delegated AE, this individual is responsible for the following:

- Provides guidance and approves project definition, scope, and budget for the CFN project to support the mission need.
- Approves the annual budget requests for the CFN project.
- Approves CFN project performance measures.
- Approves the request for Critical Decisions.
- Concurs on Level 0 and approves Level 1 Baseline Change Proposals.
- Approves assignment of the CFN Federal Project Director (FPD).

E. DOE Basic Energy Sciences (DOE/BES)

DOE/BES is the sponsoring program for this project and is responsible for execution of DOE Office of Science (SC) program activities in basic energy sciences. DOE/BES approves and provides funding allocations and project reviews, approvals and authorizations in accordance with DOE project management systems and requirements. DOE/BES approves performance baseline changes for the project below the Secretarial Acquisition Executive level and all major changes to the project scope or schedule, as defined in the change control thresholds of this PEP. DOE/BES is also responsible for utilizing the Energy Systems Acquisition Advisory Board (ESAAB) or an Equivalent Board to

approve Critical Decisions as defined in the Authorization section of this PEP. Programmatic oversight of the CFN for BES will be performed by the DOE/BES Program Manager.

F. DOE – Brookhaven Area Office (BAO)

The DOE/BAO office will provide the Federal oversight for the execution of the project to include legal, contracting, environmental and project management. The BAO Federal Project Director, having the official federal responsibility and accountability for the overall success of the project, will:

- Charter and lead the Integrated Project Team
- Tailor DOE project management requirements to the project
- Ensure timely completion and quality of required project documentation
- Assess contractor project performance versus contract requirements
- Ensure quality and timely completion of the project documentation and other deliverables
- Proactively identify and ensure timely resolution of critical issues within Federal control that impact project performance – strives to remove any barriers to project success
- Integrate and manage the timely delivery of Government reviews, approvals, property, services, and information
- Assess and reports project performance to DOE management
- Monitor contractor's risk management efforts
- Ensure implementation of the BNL Integrated Safety Management (ISM) program
- Manage DOE project contingency funds

G. CFN Director

The CFN Director has full responsibility and authority for carrying out the CFN project in a manner consistent with this PEP. The CFN Director has the continuing responsibility to develop participation and commitment from the outside research community as well guide the design and construction of the CFN to accommodate the requirements of the researchers. He is responsible for the CFN user outreach programs and future transition to the operations of the new facility. The CFN Director reports to DOE/BES through the BAO Federal Project Director.

H. CFN Project Manager (PM)

The CFN Project Manager is directly responsible for implementing management methods required to achieve the CFN project's specific objectives. He will:

- Hold the contractor responsible and accountable for successful execution of contractor's project scope of work to meet technical, schedule, cost and quality objective
- Act as a key member of the Integrated Project Team; coordinate all functions and work among various disciplines of the project; and Chairs the contactor's IPT
- Support the Federal Project Director in implementing DOE project management process and objectives
- Provide input on project documents and develops and maintains contractor project documentation
- Define and manage the contractor project organization
- Manage the day-to-day project execution activities
- Implement contractor performance measurement system
- Ensure project deliverables as defined in the contract are on time and within budget
- Proactively identify and ensure timely resolution of critical issues within contractor's control which impact project performance – strives to remove any barriers to project success
- Communicate accurate and reliable project status and performance issues to DOE management
- Identify and manage project risks
- Ensure effective implementation of Quality Assurance Plan

I. Technical Equipment Coordinators

The Technical Equipment Coordinators are directly responsible for scope, cost and schedule performance of technical design, technical procurement, technical liaison, and installation and commissioning of technical equipment. In this capacity, the Technical Equipment Coordinators will:

- Report to the CFN PM.
- Coordinate the efforts of the individual cluster leaders to assure technical performance objectives are achieved.
- Provide technical specifications to Technical Procurement Manager and assures cluster leaders act as technical liaison during procurement and contract closeout.

- Provide technical requirements for conventional facilities to the Conventional Construction Manager.
- Coordinate and oversee installation, commissioning and testing of technical equipment.
- Coordinate transition from technical construction to operation.

J. Conventional Construction Manager

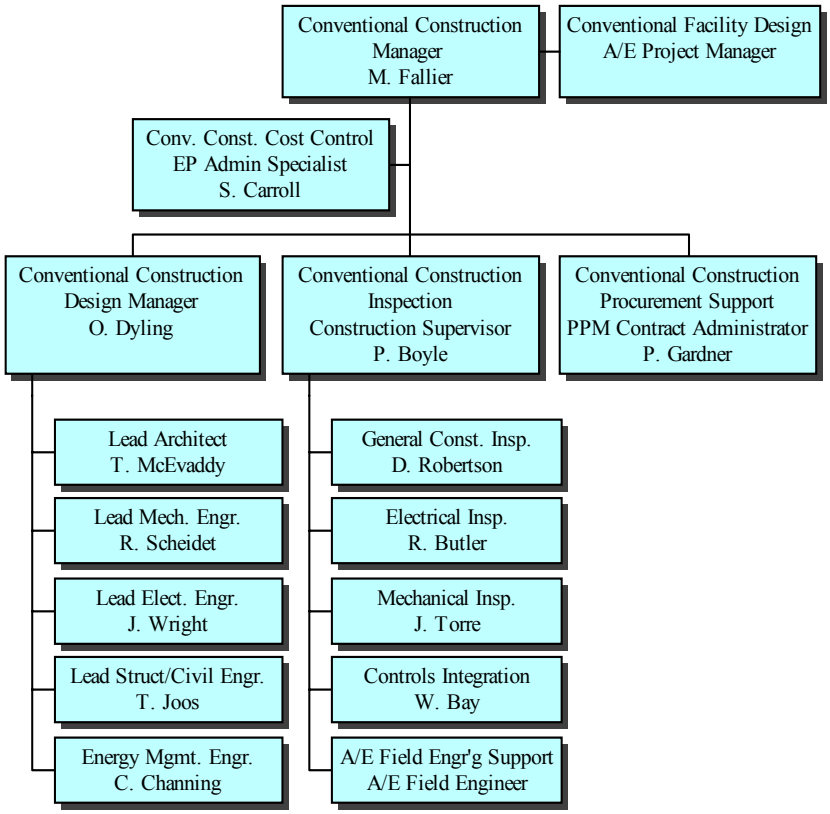
The Conventional Construction Manager is directly responsible for scope, cost and schedule performance of conventional facility design and construction. The Conventional Construction will be managed as indicated in Figure 2. In this capacity, the Conventional Construction Manager will:

- Report to the CFN PM.
- Manage the efforts of the A/E firm to perform Title I and Title II design.
- Administer the technical terms of the construction contracts and contracts with independent testing laboratories. Assure that all contractors and vendors for conventional facilities perform in accordance with the terms of their contracts and purchase orders.
- Manage the BNL engineering staff review of A/E designs and coordination with BNL utilities, systems and design standards.
- Manage the Title III construction management, inspection, quality assurance, testing and startup of conventional facilities.
- Coordinate with the Technical Equipment Coordinators to assure technical equipment requirements are incorporated into conventional facility design.
- Coordinate with ESH&Q Coordinator to assure that all ES&H regulations, permits and reviews are properly complied with and addressed in the design and construction of conventional facilities.

K. Technical Procurement Manager

The Technical Procurement Manager is responsible for preparation of bidding, award and contractual documents and oversight of all major procurements of technical equipment. The Technical Procurement Manager will assure that procurements are carried out in accordance with DOE and Federal acquisition regulations (DEAR's/FAR's), and that technical performance requirements included in the contracts are met through implementation of the Quality Assurance Program.

Figure 2
Center for Functional Nanomaterials (CFN)
Conventional Construction
Project Organization



L. Environmental, Safety, Health & Quality Coordinator

The ESH&Q Coordinator is responsible for implementing the BNL Integrated Safety Management (ISM) program for the CFN project to assure that environmental, safety and health issues are addressed in the design, construction, and ultimate operations of the CFN. The CFN ESH&Q Coordinator will interact with the Integrated Project Team and manage as indicated in Figure 3. In this capacity, the ESH&Q Coordinator will:

- Oversee preparation of Hazards Analysis and insure the facility design addresses identified hazards wherever feasible.
- Utilize appropriate BNL ESH&Q subject matter experts to prepare hazard analyses, review design documents and oversee construction activity to assure compliance with ESH&Q standards.
- Oversee performance of beneficial occupancy and occupational readiness evaluations of the CFN as required to enable timely operations in accordance with ESH&Q requirements.
- Oversee development of a Quality Assurance Plan.

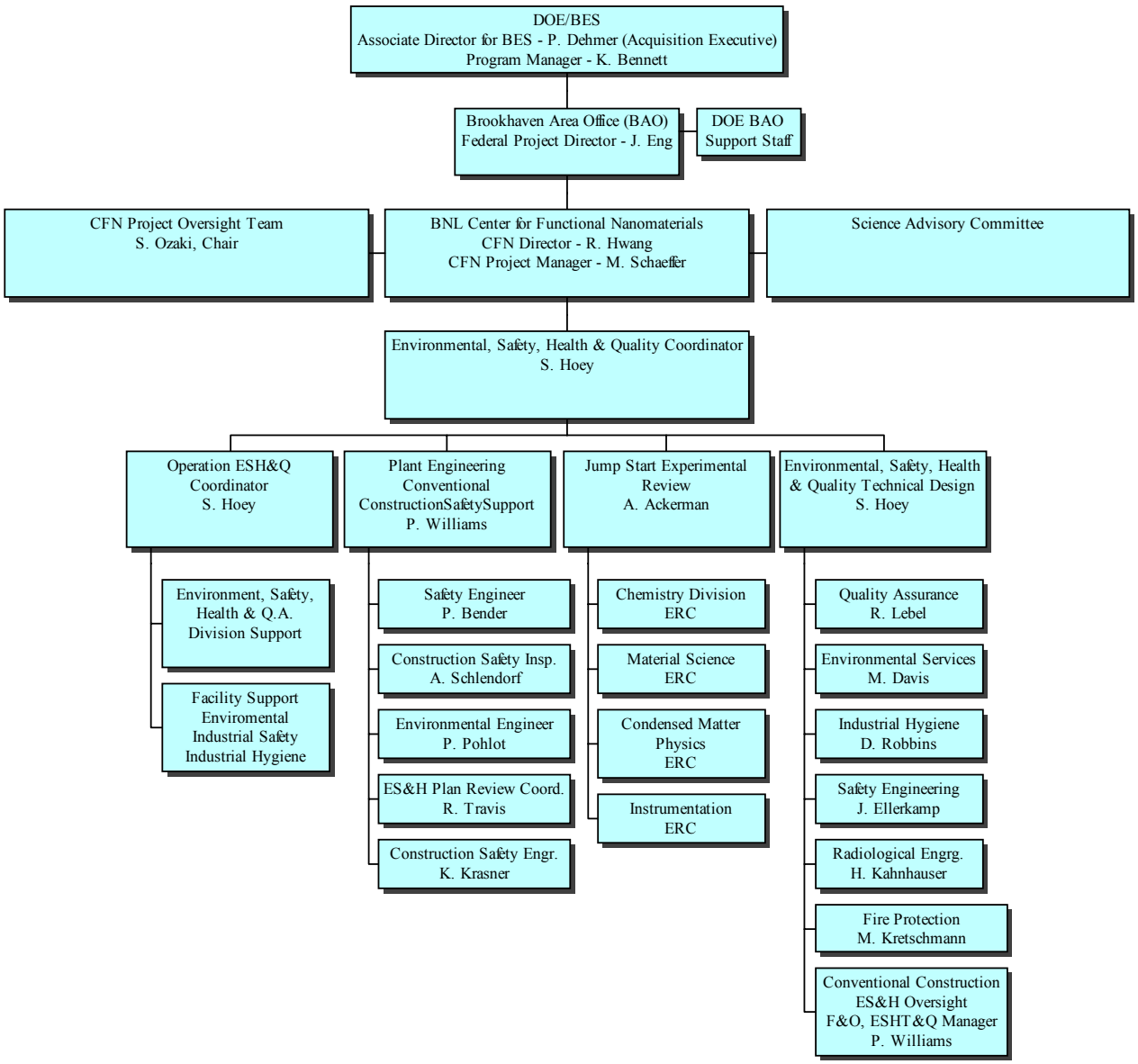
M. Cost Control Manager

The Cost Control Manager is responsible for financial accounting functions and monitoring of all project costs and obligations. The Manager tracks project funding status and establishes project accounts, and prepares and issues financial reports on a monthly basis. Provides input data to earned value performance measurement system. The Manager also serves as administrator for the baseline change control process.

N. Performance Measurement Administrator

The Performance Measurement Administrator will perform earned value performance analysis and prepare regular reports in accordance with the earned value reporting requirements of DOE Manual 413.3-1, “Project Management for the Acquisition of Capital Assets”. The Administrator prepares cost loaded activity based schedule for performance baseline using input from WBS managers, and maintains and updates baseline due to approved BCP’s.

Figure 3
Center for Functional Nanomaterials (CFN)
ESH&Q



O. Conventional Facility Design A/E Project Manager (Figure 2)

The A/E Project Manager will be responsible for preparation of Title I, Title II design reports, drawings and specifications for the CFN and will provide Title III support during facility construction. The A/E Project Manager will report to the BNL Conventional Construction Manager and will prepare all CFN designs in accordance with applicable DOE, Federal and BNL contract requirements.

P. Cluster Leaders

The Cluster Leaders will be responsible for developing the technical performance criteria for their assigned research area, preparing equipment specifications for procurement and design requirements for the supporting conventional facilities needed to achieve the CFN's technical performance objectives. The Cluster Leaders will coordinate and interpret user outreach feedback in concert with DOE program guidance and BNL collaborating departments to develop the program and capability of each cluster. Cluster Leaders will coordinate and oversee procurement, startup and commissioning for operations of instruments in their respective clusters.

Q. Conventional Construction Design Manager (Figure 2)

The Conventional Construction Design Manager will coordinate the technical design requirements of the Cluster Leaders, ESH&Q design requirements and BNL's conventional facility design requirements with the A/E Project Manager to assure all BNL design requirements are incorporated by the A/E firm.

R. CFN Project Oversight Team

The CFN Project Oversight Team conducts periodic, independent reviews of the BNL CFN project. The Team performs formal technical, cost, schedule, ES&H and management reviews prior to Critical Decisions to assess project progress, identify issues, and provide recommendations for improvement. The CFN project baseline (Project Data Sheet and 100% Title I documents) will be the reference documents for the reviews. Findings, conclusions, recommendations and action items from each review are formally documented in a written report that is provided to the Deputy Director for Science & Technology.

S. Science Advisory Committee

The Center for Functional Nanomaterials (CFN) is one of five Nanoscale Science Research Centers (NSRCs) supported by DOE's Basic Energy Sciences. It is a user research facility for the synthesis, processing, and characterization of nanoscale materials. The CFN will achieve this mission by providing access to specialized equipment and support staff that is coupled to a vibrant internal research community at Brookhaven. Access to the CFN is determined by peer review of proposals.

The CFN Science Advisory Committee (SAC) is a committee of distinguished scientists, not all specializing in nanoscience, from outside BNL. They are appointed by senior management at BNL based on nominations by the User Community, the Center management, and its advisory bodies, and report to the Associate Laboratory Director for Basic Energy Sciences. The SAC is charged to review and provide guidance in the following areas:

1) Quality, productivity and direction of the internal research portfolio
2) Interaction with scientific user community
3) Quality and productivity of the User Scientific Program
4) Infrastructure, capabilities and management

T. CFN Project Management Team

The CFN Project Management Team is led by the CFN Director and includes the CFN Project Manager, Technical Equipment Coordinators, Conventional Construction Manager, Technical Procurement Manager, Environmental , Safety, Health & Quality Coordinator, Cost Control Manager, and Performance Measurement Administrator. The team is responsible for the following:

- Assign action items to appropriate team members and track the issue until completed.
- Consult with the CFN Project Oversight Team when approaching critical decisions.
- Identify, prepare, and manage documentation needed for successful management of the project.

U. Authorities

The section describes the responsibilities and authorities for the development, review, and recommendation and approval of deliverables required during the CFN project (see Figure 4). These authorities are a subset of a larger set of authorities for project deliverables and are derived from DOE M 413.3-1.

Figure 4
CFN Authorities Matrix

	BNL		DOE	
Major Project Milestone, Document, or Action	**CFN Project Manager & Conv. Constr. Manager**	**CFN Director**	**CFN Federal Project Director**	**Acquisition Executive (AE) SC-10**
CD-0 Approval of Mission Need	Prepares	Reviews	Reviews & Recommends Approval	Approves
Conceptual Design Report (CDR)	Prepares	Reviews	Reviews & Recommends Approval	
Project Execution Plan (PEP)	Provides Project Plan	Provides Input	Prepares & Recommends Approval	Approves
Acquisition Strategy	Provides Input	Provides Input	Prepares & Recommends Approval	Concurs
Project Data Sheet (PDS)	Prepares	Reviews & Concurs	Reviews & Concurs	Approves
CD-1 Alternative Selection & Cost Range	Requests Decision	Recommends Approval	Recommends Approval	Approves
Title I Design Package/Perf Specs	Prepares/Presents	Reviews & Approves	Reviews & Approves	
Pre-CD-2 External Independent Review (EIR)	Presents Project Information	Provides Input to EIR Report & CAP	Prepares Responses to EIR Report; Prepares & Tracks CAP	Receives Information Copy
CD-2 Performance Baseline	Prepares	Recommends Approval	Recommends Approval	Approves
Title II Design Package	Prepares/Presents	Reviews & Recommends Approval	Reviews and Approves	
Pre-CD-3 Independent Project Review (IPR)	Presents Project Information	Provides Input to IPR & CAP	Prepares Responses to IPR Report; Prepares & Tracks CAP	Receives Information Copy
CD-3 Start Construction	Requests Decision	Recommends Approval	Recommends Approval	Approves
CD-4a Start of Initial Operations	Requests Decision	Recommends Approval	Recommends Approval	Approves
CD-4b Start of Full Operations	Requests Decision	Recommends Approval	Recommends Approval	Approves
Final Cost Report	Prepares	Recommends Approval	Approves	

Note: CAP – Corrective Action Plan EIR – External Independent Review
IPR – Independent Project Review

5. WORK BREAKDOWN STRUCTURE

1.0 Center for Functional Nanomaterials

A. As shown in Figure 5, the project work breakdown structure, WBS 1.0 – BNL Center for Functional Nanomaterials is divided into five main categories: 1.1 - Project Support, 1.2 - Technical Equipment, 1.3 - Conventional Construction, 1.4 - Standard Equipment, and 1.5 - Other Project Costs. These items are further divided into major WBS elements.

B. WBS 1.1 - Project Support:

WBS 1.1.1 – Project Management - includes all work to manage the project in accordance with this Preliminary Project Execution Plan and compliance with DOE Manual 413.3-1, “Project Management for the Acquisition of Capital Assets”. This WBS also includes the implementation of the BNL Project Management Control System (PMCS); procedures and application of control systems to include oversight and evaluation of the project. It includes the control of project baselines, contingency and Earned Value Management in accordance with ANSI standard EIA-748 which will be used for performance management throughout the life of the project.

WBS 1.1.1.1 – Project Management - Design Phase includes all work to manage the project during the design phase in accordance the approved Preliminary Project Execution Plan and the DOE Manual 413.3-1, “Project Management for the Acquisition of Capital Assets”. The Project Manager has the overall responsibility for the project’s performance, cost, and schedule and leads a team of individuals who contribute to the overall project objectives. Included are day-to-day project management, team meetings, authorizations, project estimates, analysis and control, change control, risk management, management plans and revisions, and reporting and documentation.

WBS 1.1.1.1.1 – Project Management - Conventional Design includes the management effort to support the design phase of the project, including overseeing the A/E Title I and Title II design, developing RFQ documents, and project controls.

WBS 1.1.1.1.2 – Design Management – Conventional Design involves reviewing the building design by the BNL Plant Engineering design staff, coordinating with the A/E project team, and interacting with the customer and consultants. This includes design team meetings.

WBS 1.1.1.1.3 – Project Management - Technical Design includes the management effort to support the technical design phase of the project including managing the preparation of specifications for the technical equipment. It also includes technical management support during the design phase of the building.

WBS 1.1.1.2 – Project Management - Construction Phase includes all work to manage the project during the construction phase in accordance with BNL's Preliminary Project Execution Plan, DOE Manual 413.3-1 and includes implementation of the BNL Construction Safety Program.

WBS 1.1.1.2.1 – Project Management - Conventional Construction includes all the project management effort to support the conventional construction phase of the project including earned value management and project controls.

WBS 1.1.1.2.2 – Project Management - Technical Equipment includes all the project management effort to support the technical construction phase of the project including overseeing the installation of technical equipment.

WBS 1.1.2 – Project Engineering - includes Title I & II engineering, value engineering, shop drawing review, and Title III construction inspection services, and includes implementation of the BNL Construction Safety Program.

WBS 1.1.2.1 – Project Engineering - Design Phase includes all work to design the CFN building including Title I, and Title II engineering.

WBS 1.1.2.1.1 – Project Engineering – A/E Title I Design is the preliminary design development phase, which usually consists of 30 to 40 percent of the design effort. During this phase schematic design is done for all building systems, and typical elevations and sections are developed. Very little work

is performed on details, sections, and schedules or materials. The intent of Title I is to design the project at a level of detail that can be presented to the customer base to confirm that the project is on the proper course for performance, cost, and schedule.

WBS 1.1.2.1.2 – Project Engineering – A/E Title II design is the final design development phase. All plans, sections, details, and specifications are completed during this phase. A final cost estimate is completed. A customer review of the completed design is also performed. The deliverable from this phase is the bid document package.

WBS 1.1.2.1.3 – Project Engineering - Technical Design includes all the project design effort to support the technical engineering phase of the project. This includes development of instrument specifications and procurement packages.

WBS 1.1.2.2 – Project Engineering - Construction Phase includes the engineering effort to support the construction phase of the project.

WBS 1.1.2.2.1 – Project Engineering - Conventional Construction includes the project engineering effort to support the conventional construction activity. This includes shop drawing review, construction inspection, change orders, and quality assurance.

WBS 1.1.2.2.2 – Project Engineering - Technical Equipment includes all the engineering effort by the scientific staff to support laboratory and clean construction during the construction phase of the project.

WBS 1.2 – Technical Equipment - Consists of competitively bid (where possible), lump sum contracts, as well as in-house fabrication, assembly, installation and testing. The tasks within each WBS element are broken down as follows:

WBS 1.2.1 – Nanopatterning

New state-of-the-art electron beam, ion beam, and deep ultraviolet patterning; plasma deposition, gas vapor deposition, and vacuum deposition; plasma, wet-chemical etching and appropriate packaging methods to fabricate nanomaterials with nanoscale precision.

WBS 1.2.2 – Ultrafast Optical Sources

These laboratories will utilize standard and customized laser sources for the following applications: (1) ultrafast laser probes for examining issues in nanostructures, (2) new sources such as femto-second pulses and X-ray generation from laser-electron beam interactions, and (3) surface non-linear optical probes including second harmonic generation.

WBS 1.2.3 – Electron Microscopy

Planned for acquisition are two transmission electron microscopes including a 200kV instrument with a field emission gun. An ultra-high resolution scanning electron microscope will be available for examination of specimens and quantitative measurements. A sophisticated sample preparation lab will also be installed.

WBS 1.2.4 – Materials Synthesis

This suite of laboratories is designed to provide a range of thin film, bulk, and soft material synthesis capabilities. Preparation equipment included in these laboratories are a thin film deposition system and an electron beam evaporator. Analytical and characterization facilities constitute a major portion of the investment. Equipment includes x-ray diffraction, a magnetometer, thermal properties measurement apparatus, and a nuclear magnetic resonance (NMR) installation.

WBS 1.2.5 – Proximal Probes

These laboratories are to be equipped for optical characterization of samples using IR, UV and Raman spectroscopy and confocal microscopy, and near-field scanning optical microscopy (NSOM). A development laboratory for spectroscopic near-field microscopy using IR and UV Raman techniques as well as a low energy electron microscope. General purpose chemistry laboratory for sample preparation. A wet chemical laboratory for sample preparation and analysis.

WBS 1.2.6 – Theory & Computation

This laboratory cluster provides state-of-the-art software and computational equipment, i.e., a Linux cluster computer, with approximately 200 processors.

WBS 1.2.7 – CFN Endstations at NSLS

A small-angle x-ray scattering end station will be constructed by the BNL CFN. The major components of the end station are an area detector, position sensitive detector, scattering system, optics and microscopes.

WBS 1.3 – Conventional Construction - Consists of competitively bid, lump sum contracts. The tasks within each WBS element are broken down as follows:

WBS 1.3.1 – Improvements to Land - includes all costs associated with clearing and grubbing, site work, landscaping, sidewalks. It also includes curbing, paving, and vehicle access to the building. Compusult section B. Site Work.

WBS 1.3.2 – Building – Typically, construction includes the overall building structure, main mechanical and electrical equipment located in equipment rooms and penthouses, primary building distribution mechanical and electrical systems, the lightning protection system, elevator, emergency lighting system, exterior finish, roof, windows, secondary systems, and interior spaces as required by the specific building occupants.

WBS 1.3.2.1 – Building Architectural - Construction includes the overall building structure, elevator, exterior finishes, windows, and interior spaces as required by the specific building occupants. The following sections from the Compusult detailed construction cost estimate make up this WBS. 1. Substructure, 2. Superstructure, 3. Exterior Closure, 4. Roofing, 5. Interior Construction, 6. Interior Finishes, 7. Building Specialties, 8. Equipment, 9. Furnishings, 10. Special Construction, and 11. Conveying Systems.

WBS 1.3.2.2 – Building Mechanical - Construction includes the main mechanical equipment located in equipment rooms and penthouses, and primary building distribution mechanical systems and its controls. Compusult Section 15. HVAC & Controls.

WBS 1.3.2.3 – Plumbing - Construction includes the installation of the plumbing distribution systems. Compusult Section 12. Plumbing & Waste Water Systems & Section 13. Process Systems.

WBS 1.3.2.4 – Fire Protection - Construction includes the installation and controls of the fire protection equipment and distribution systems. Compusult Section 14. Fire Protection.

WBS 1.3.2.5 – Electrical - Construction includes the power and lighting distribution of these electrical systems. Compusult Section 16. Electrical/Life Safety/Telecom.

WBS 1.3.3 – Utilities - includes providing services such as water, steam, sanitary waste, voice communication and data, chilled water, compressed air, and electrical to the building.

WBS 1.3.3.1 – Mechanical - Construction includes the site mechanical equipment and distribution systems. Compusult Section B. Site Work & Section 15. HVAC & Controls.

WBS 1.3.3.2 – Electrical - Construction includes the site electrical equipment and power distribution to building. Compusult Section B. Site Work.

WBS 1.3.4 – Other Construction Costs – includes demolition or relocation of the existing Teachers Federal Credit Union (TFCU), Building 193 and contribution to a new satellite chiller plant to be located in Building 555. The satellite chiller plant will consist of 2 – 650 ton chillers, cooling tower and associated piping and controls. The satellite chiller plant will add capacity to the Central Chilled Water Plant and provide chilled water to the CFN.

WBS 1.3.4.1 – Demolition/Relocation of the TFCU - Construction includes the demolition/relocation of the building.

WBS 1.3.4.2 –Satellite Chiller Plant - Construction includes the installation of chillers and its associate distribution systems in a remote location.

WBS 1.4 – Standard Equipment includes office furniture, personal computers, blinds and equipment that are off the shelf or only require nominal engineering.

WBS 1.5 – Other Project Costs – major support activities are charged to OPC, these include Conceptual Design Costs, NEPA final hook-up and testing, and commissioning activities.

WBS 1.5.1 – Conceptual Design Report (CDR) – the CDR summarizes investigations to establish baseline scope, schedule, and cost information. Approval of the CDR is required before the CFN project can compete for congressionally approved Capital funds and receive Critical Decision 1 (CD-1), Approval of Preliminary Baseline.

WBS 1.5.2 – National Environmental Policy Act (NEPA) – includes tasks for preparation and documentation needed for the NEPA process to determine if further NEPA documentation is required or a categorical exclusion (CX) will be issued.

WBS 1.5.3 – Hazards Analysis – preparation of hazards analysis document for the CFN project.

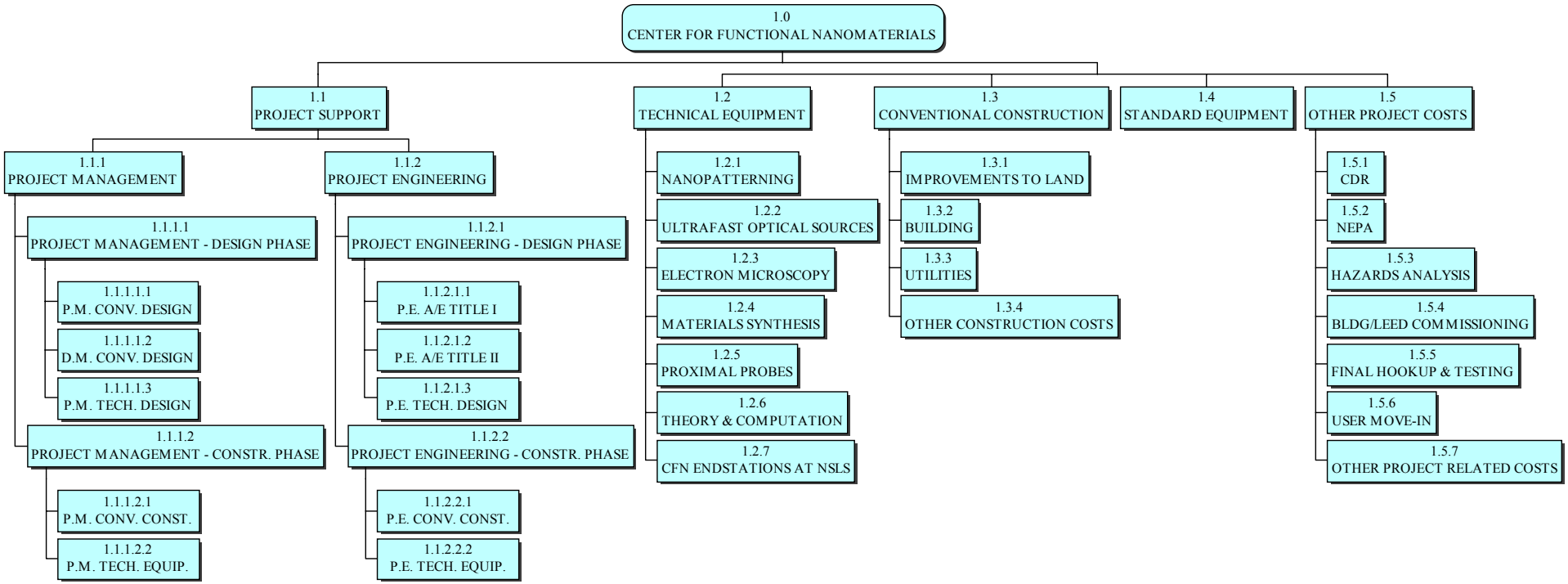
WBS 1.5.4 – Building/LEED Commissioning – includes Plant Engineering (EP) Construction Support and EP Operations and Maintenance during commissioning activities along with a Commissioning Agent.

WBS 1.5.5 – Final Hook-up and Testing – includes activities needed to ready the facility and equipment to operate safely and effectively.

WBS 1.5.6 – User Move-in – includes activities and costs associated with moving staff/users into the new building.

WBS 1.5.7 – Other Project Related Costs – includes minor project management to coordinate efforts through completion for turnover to the facility owner. Project management will coordinate with the contractor and the designer for support needed during this phase. It also includes any ESH&Q support needed to bring the facility to safe operations.

Figure 5
Center for Functional Nanomaterials (CFN)
Work Breakdown Structure (WBS)



6. ACQUISITION STRATEGY

The CFN Acquisition Strategy is attached as a separate document, see Appendix B.

7. PROJECT BASELINES

A. Baseline Establishment

The initial technical, cost, and schedule baselines for the CFN Project are formally established by approval of this Project Execution Plan. These initial baselines will be evaluated and finalized at Critical Decision 2. Any changes to the approved Baselines after CD-2 will follow the "Project Management and Change Control" section of this document.

B. Baseline Scope:

The CFN facility will be a two-story building of approximately 94,500 square feet, housing wet and dry laboratories (including Class 1000 and Class 100 clean areas), office space for CFN staff and users, and conference rooms. In addition to offices and laboratories, it will house "interaction areas" for informal discussions and lunch rooms on each floor to foster scientific discourse.

Material and system selections will address the principles of sustainable design to insure low energy and maintenance costs over the life of the building. Features will be incorporated into the building design to satisfy the environmental requirements of the nanoscience instrumentation, i.e., vibration isolation, temperature controls as precise as $\pm$ 0.1 degrees C and shielding from electromagnetic interference.

The BNL Center for Functional Nanomaterials will be across the street from the existing NSLS. Siting of the CFN will take advantage of proximity to the Instrumentation Division (Building 535), and the Departments of Physics (Building 510), Materials Science (Building 480), and NSLS (Building 725), which are key interdisciplinary participants in nanoscience research.

The CFN will create laboratories capable of performing leading-edge research in functional nanomaterials utilizing state-of-the-art equipment and capable of supporting collaborative user research teams in the following areas. The baseline technical equipment list for the CFN is included in the System Functions and Requirements Document.

WBS 1.2.1 Nanopatterning

The Nanopatterning Cluster will employ state-of-the-art electron beam, ion beam, and deep ultraviolet patterning; plasma deposition, gas vapor deposition, and vacuum deposition; plasma, wet-chemical etching and appropriate packaging methods to fabricate nanoscale materials with precision.

WBS 1.2.2 Ultrafast Optical Sources

The Ultrafast Optical Source Cluster will provide a suite of techniques probing the structure and dynamics of nanostructured systems on the femtosecond time scale. Several laser systems will serve a number of experimental stations, configured for different nonlinear optical probes and femtosecond pump-probe geometries, offering researchers the broadest range of available techniques.

WBS 1.2.3 Electron Microscopy

Due to advances in electron optics aberration correction and quantitative electron microscopy instrumentation, a new generation of transmission electron microscope (TEM) can now be designed and built. These instruments will be capable of image resolution better than 0.1 nm and spectroscopic resolution better than 1 eV. The planned full-featured TEM/STEM electron microscope will include special purpose sample stages (temperature control and differential pumping capability) that convert a microscope into a true experimental nanomaterials laboratory.

WBS 1.2.4 Materials Synthesis

The Materials Synthesis Cluster is designed to provide a range of thin film, bulk, and soft material synthesis capabilities. Analytical and characterization equipment constitute a major portion of the investment. These items complement not only the synthesis efforts based within the Cluster, but directly support the other Cluster laboratories in the CFN.

WBS 1.2.5 Proximal Probes

The Proximal Probes Laboratory Cluster will provide state-of-the-art capabilities in scanning probe techniques, as well as optically-based confocal and near-field microscopes, for developing the next generation of scanning probes based on spectroscopic “chemical” imaging. The Proximal Probes Cluster includes four fully

instrumented Scanning Probe Microscopy laboratories and an ancillary wet chemical laboratory for sample preparation and analysis.

WBS 1.2.6 Theory and Computation

The Theory and Computing Laboratory Cluster was conceived to provide state-of-the-art software and computational facilities for users as well as a path for interaction between users and the theoretical community at BNL and beyond.

WBS 1.2.7 CFN Endstations at NSLS

A state-of-the-art small-angle scattering endstation will be constructed by the CFN. Small angle x-ray scattering (SAXS) is the most important experimental technique for determining the size, shape, and internal electron density distribution of nanoparticles, and correlations among nanoparticles.

C. Cost Baseline

The project cost estimate in at-year dollars, including escalation and burden has a TEC of $79.7 million with budget authority of $0.988 million in FY 2003, $2.982 million in FY 2004, $20.477 million in FY 2005, $36.553 million in FY 2006, and $18.7 million in FY 2007.

WBS 1.0	BNL Center for Functional Nanomaterials		
WBS 1.1	Project Support		$ 8,538,000
	1.1.1 - Project Management	$ 4,166,000	
	1.1.2 - Project Engineering	4,372,000	
WBS 1.2	Technical Equipment		$ 26,393,000
	1.2.1 - Nanopatterning	$ 7,472,000	
	1.2.2 - Ultrafast Optical Sources	3,042,000	
	1.2.3 - Electron Microscopy	5,850,000	
	1.2.4 - Materials Synthesis	2,759,000	
	1.2.5 - Proximal Probes	5,628,000	
	1.2.6 - Theory and Computation	602,000	
	1.2.7 - CFN Endstations at NSLS	1,040,000	
WBS 1.3	Conventional Construction		$ 32,349,000
	1.3.1 - Improvements to land	$ 865,000	
	1.3.2 - Building	26,957,000	
	1.3.3 - Utilities	3,700,000	
	1.3.4 - Other Construction Costs	827,000	
WBS 1.4	Standard Equipment		$ 903,000
	Contingency		$ 11,517,000
	Total Estimated Cost (TEC)		$ 79,700,000*
WBS 1.5	Other Project Costs (OPC)		$ 1,300,000
	Total Project Cost (TPC)		$ 81,000,000

*(Escalated, At-Year Dollars, Rounded to Nearest $1,000
Includes BNL's indirect costs of $ 2,812,000)

D. Schedule Baseline

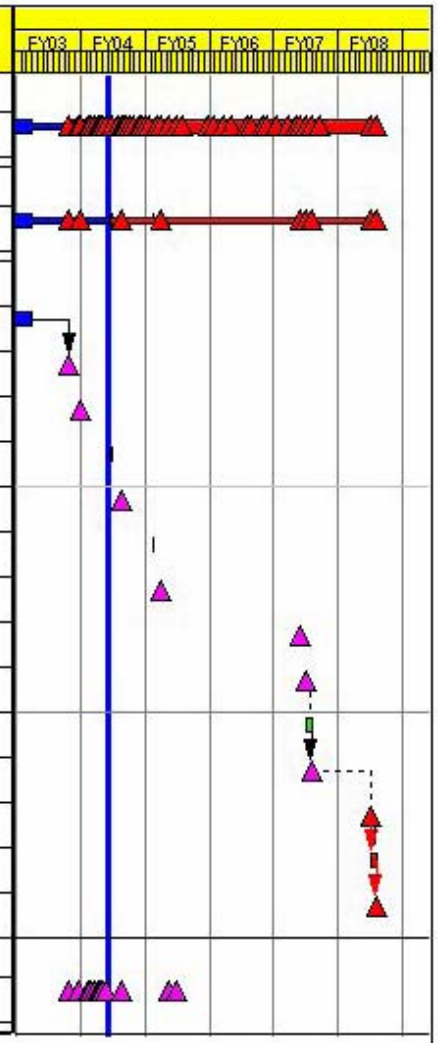
CD-0 – Approve Mission Need	06/12/02 (A)
CDR Review and Approval (BNL)	12/31/02 (A)
CD-1 – Approve Alternative Selection & Cost Range	07/23/03 (A)
NEPA Approval	10/06/03 (A)
Conventional Construction	
Start Title I – Preliminary Design	08/01/03* (A)
Complete Title I – Preliminary Design	02/20/04 (A)
Start Title II – Detail Design	03/01/04 (A)
External Independent Review (EIR)	03/22/04 (A)
CD-2 – Approve Performance Baseline	05/21/04*
Complete Title II Detail Design	09/30/04*
Independent Project Review (IPR)	11/15/04
CD-3 – Approve Start of Construction	12/31/04*
Award Contract	03/31/05
Issue Notice to Proceed	05/02/05
Start Construction	06/01/05*
Complete ORE for Beneficial Occupancy	02/28/07
Complete Construction	03/30/07*
CD-4a – Approve Start of Initial Operations	04/30/07*
Technical Equipment	
Technical Design Start	10/01/04*
CD-3 – Approve Start of Construction	12/31/04*
Procurement Start	01/03/05
Technical Design Complete	07/31/06*
Procurement Complete	03/30/07
Installation and Testing Start	04/02/07*
Installation and Testing Complete	03/31/08*
CD-4b – Approve Start of Full Operations	04/30/08*

*Major Milestone

(A) - Actual

CFN Project Schedule

Activity ID	Activity Description	Budgeted Cost	Orig Dur	Early Start	Early Finish
1 CENTER FOR FUNCTIONAL NANOMATERIALS (CFN)					
Subtotal		81,000,000	1,473	13JUN02A	30APR08
1.0 CENTER FOR FUNCTIONAL NANOMATERIALS (CFN)					
Subtotal		0	1,473	13JUN02A	30APR08
1000005	C D - 0 APPROVAL - Mission Need	0	0		12JUN02A
1000007	Conceptual Design Report	0	200	13JUN02A	31DEC02A
1000010	CD-1 APPROVAL-Alternative Selection & Cost Range	0	0		23JUL03A
1000015	NEPA (CX)	0	0		06OCT03A
1000018	EIR	0	5	22MAR04*	26MAR04
1000020	C D - 2 APPROVAL-Performance Baseline	0	0		21MAY04
1000022	IPR	0	4	15NOV04*	18NOV04
1000030	C D - 3 APPROVAL- Start of Construction	0	0		31DEC04
1000035	Beneficial Occupancy	0	0		28FEB07
1000051	Conventional Construction Complete	0	0		30MAR07
1000055	ESAAB/Preparation for ESAAB for CD-4a	0	21	02APR07	30APR07
1000057	CD-4a APPROVAL-Start of Initial Operations	0	0		30APR07
1000059	Technical Equipment Installation Complete	0	0		31MAR08
1000065	ESAAB/Preparation for ESAAB for CD-4b	0	22	01APR08	30APR08
1000069	CD-4b APPROVAL-Start of Full Operations	0	0		30APR08
1.1 PROJECT SUPPORT					
Subtotal		8,537,630	1,188	01AUG03A	28APR08



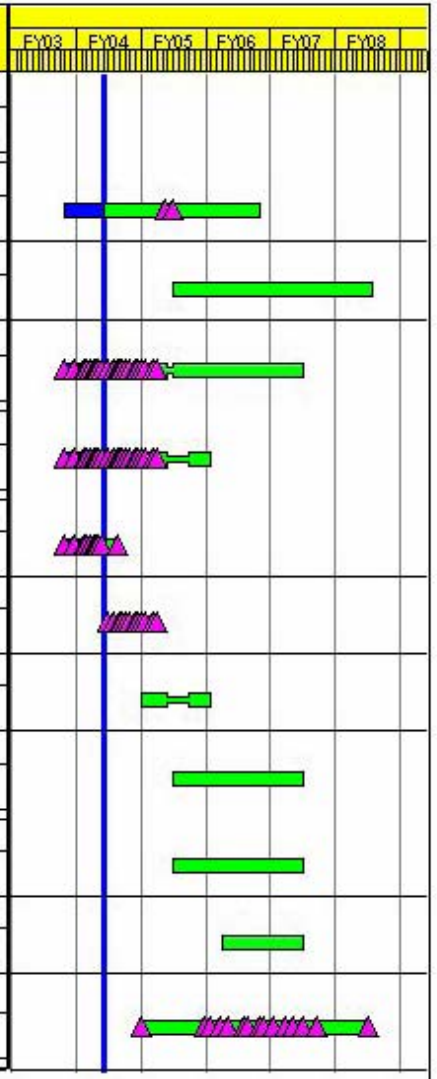
Start Date 27MAR02
Finish Date 30APR08
Data Date 01MAR04
Run Date 07MAY04 08:29

Early Bar
Progress Bar
Critical Activity

CF17 Sheet 1 of 3

Brookhaven National Laboratory
CENTER for FUNCTIONAL NANOMATERIALS
[C F N]
Summary Schedule

Activity ID	Activity Description	Budgeted Cost	Orig Dur	Early Start	Early Finish
1. 1.1 Project Management					
Subtotal					
+ 1. 1.1 .1	Project Management - Design Phase				
		2,080,560	751	01AUG03A	31JUL06
+ 1. 1.1 .2	Project Management - Construction Phase				
		2,085,029	771	01APR05	28APR08
1. 1.2 Project Engineering					
Subtotal		4,372,041	917	01AUG03A	30MAR07
1. 1.2 .1	Project Engineering - Design Phase				
Subtotal		3,250,779	565	01AUG03A	31OCT05
+1. 1.2 .1 .1	PE/AE Title I				
		1,375,300	203	01AUG03A	21MAY04
+1. 1.2 .1 .2	PE/AE - Title II				
		1,022,000	212	01MAR04	31DEC04
+1. 1.2 .1 .3	PE Technical Design				
		853,479	272	01OCT04	31OCT05
1. 1.2 .2	Project Engineering - Construction Phase				
Subtotal		1,121,262	500	01APR05	30MAR07
+1. 1.2 .2 .1	PE Conventional Construction				
		857,931	500	01APR05	30MAR07
+1. 1.2 .2 .2	PE Technical Equipment				
		263,331	312	02JAN06	30MAR07
1. 2 Technical Equipment					
Subtotal		26,393,156	875	01OCT04	31MAR08



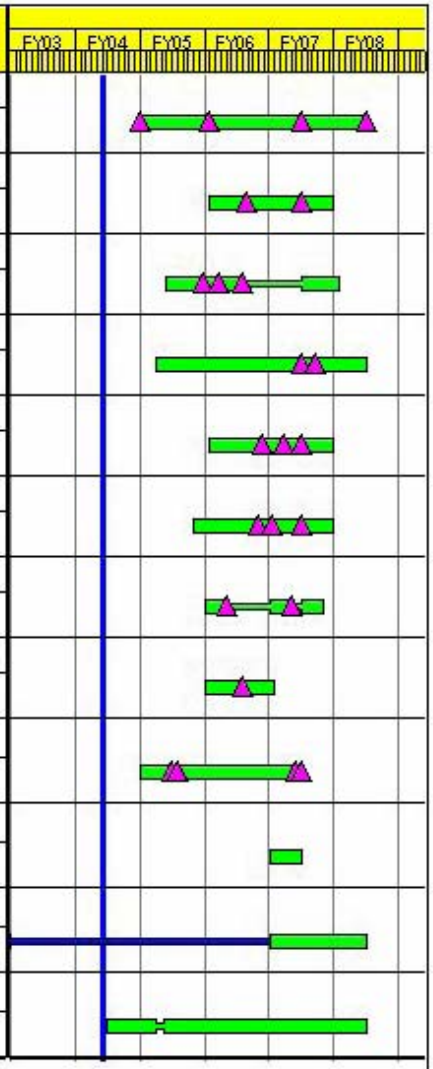
Start Date 27MAR02
Finish Date 30APR08
Data Date 01MAR04
Run Date 07MAY04 08:29

Early Bar
Progress Bar
Critical Activity

CF17 Sheet 2 of 3

Brookhaven National Laboratory
CENTER for FUNCTIONAL NANOMATERIALS
[C F N]
Summary Schedule

Activity ID	Activity Description	Budgeted Cost	Orig Dur	Early Start	Early Finish
+ 1. 2. 0	Technical Construction				
		0	875	01OCT04	31MAR08
+ 1. 2. 1	Nanopatterning [N P]				
		7,471,464	478	01NOV05	28SEP07
+ 1. 2. 2	Ultrafast Optical Sources [U F]				
		3,042,384	676	23FEB05	31OCT07
+ 1. 2. 3	Electron Microscopy [E M]				
		5,849,671	813	03JAN05	31MAR08
+ 1. 2. 4	Material Synthesis [MS]				
		2,759,406	478	01NOV05	28SEP07
+ 1. 2. 5	Proximal Probes [P P]				
		5,627,986	548	25JUL05	28SEP07
+ 1. 2. 6	Theory & Computation [T & C]				
		602,518	457	03OCT05	31JUL07
+ 1. 2. 7	CFN End Stations at NSLS				
		1,039,727	268	03OCT05	25OCT06
+ 1. 3	Conventional Construction				
		32,348,616	624	01OCT04	30MAR07
+ 1. 4	Standard Equipment				
		903,142	123	02OCT06	30MAR07
+ 1. 5	Other Project Costs				
		1,300,000	1,451	13JUN02A	31MAR08
+ 1. 6	Contingency				
		11,517,456	1,002	01APR04	31MAR08



Start Date 27MAR02
Finish Date 30APR08
Data Date 01MAR04
Run Date 07MAY04 08:29

Early Bar
Progress Bar
Critical Activity

CF17 Sheet 3 of 3

Brookhaven National Laboratory
CENTER for FUNCTIONAL NANOMATERIALS
[C F N]
Summary Schedule

E. CFN Technical Equipment Baseline

WBS	New Room #	Cluster	Equipment	Equipment Tag #	Estimate Source	FY Order Date	unit price (1000's)	total price (1000's)	Escalated Price
1.2.1	1L47	Nanopatterning	JBX 9300 FS Electron Beam Lithography Unit	NP-2	Quote	2006	4500	4500	4,770.0
	1L45	Nanopatterning	FEI Nova 200 Focused Ion Beam System	NP-9	Quote	2006	1160	1160	1,227.0
	1L46	Nanopatterning	Molecular Imprints Imprio 55 Nanoimprinter	NP-10	Quote	2006	596	596	630.5
	1L42	Nanopatterning	Trion Phantom III Deep Silicon Etch System	NP-13	Quote	2006	252	252	266.0
	1L46	Nanopatterning	EVG 101 Advanced Spin Coating System	NP-1	Quote	2007	157	157	170.6
		Nanopatterning	Miscellaneous Equipment		Estimate	2007	78	78	85.1
		Nanopatterning Total						**6,743.0**	**7,149.2**
1.2.2	1L01	Ultrafast Optical Sources	0.01-2.5 kHz 4 mJ nm Laser System	UF-1	Q & E	2005	364	364	374.5
	1L01	Ultrafast Optical Sources	0.01-2.5 kHz 4 mJ nm Laser System	UF-2	Q & E	2006	364	364	384.9
	1L01	Ultrafast Optical Sources	Nonlinear frequency synthesis set-ups (OPA/SFG/DFG/white light cont.)	UF-3	Quote	2005	110	110	113.2
	1L01	Ultrafast Optical Sources	Nonlinear frequency synthesis set-ups (OPA/SFG/DFG/white light cont.)	UF-4	Quote	2006	110	110	116.4
	1L01	Ultrafast Optical Sources	Surface Science Experimental Station	UF-5	Estimate	2005	130	130	133.8
	1L01	Ultrafast Optical Sources	Vacuum Chambers	UF-6,UF-7	Estimate	2006	20	40	42.3
	1L01	Ultrafast Optical Sources	Turbo-Pump Station	UF-11,UF-16	Estimate	2006	15	30	31.7
	1L01	Ultrafast Optical Sources	Ultrafast System	UF-8	Q & E	2005	265	265	272.7
	1L01	Ultrafast Optical Sources	Power Amplifier	UF-9	Q & E	2006	302	302	319.5
	1L01	Ultrafast Optical Sources	Monochromator	UF-17	Quote	2006	37.6	37.6	39.7
	1L01	Ultrafast Optical Sources	Streak Camera	UF-10	Quote	2006	188	188	198.9
	1L01	Ultrafast Optical Sources	Optical Table & Legs	UF-12 (3 items)	Estimate	2005	20	60	61.7
	1L01	Ultrafast Optical Sources	Optical Table & Legs	UF-12 (3 items)	Estimate	2006	20	60	63.5
	1L01	Ultrafast Optical Sources	3 GHz Digital Oscilloscope	UF-13	Quote	2005	42.5	42.5	43.7
	1L01	Ultrafast Optical Sources	500 MHz Oscilloscope	UF-14	Quote	2005	16.3	32.6	33.5
	1L01	Ultrafast Optical Sources	Vacuum Compressor & XUV/SXR Chamber	UF-15	Estimate	2006	80.0	80.0	84.6
		Ultrafast Optical Sources	Miscellaneous Equipment		Estimate	2005	134.2	134.2	138.1
		Ultrafast Optical Sources Total						**2,349.6**	**2,452.6**
1.2.3	1L30	Electron Microscopy	STEM (Nion UltraSTEM200)	EM-4	Quote	2005	4850	4850	4,990.7
		Electron Microscopy	Sample Prep Laboratory (South Bay Tech)	detail in full file	Quote	2007	500	500	542.7
		Electron Microscopy	Miscellaneous Equipment		Estimate	2007	55.93	55.93	60.7
		Electron Microscopy Total						**5,405.9**	**5,594.1**
1.2.4	1L09	Materials Synthesis	Experimental X-Ray Diffractometer (Tabletop)	MS-1	Quote	2007	66	66	71.8
	1L12	Materials Synthesis	Molecular Beam Epitaxy (MBE)	MS-2	Quote	2006	789	789	834.7
	1L04/1L07	Materials Synthesis	Glove boxes (2, see spreadsheet for details)	MS-17(2 ea)	Quote	2007	55	109	118.5
	1L19	Materials Synthesis	Thermal Measurement Lab (TG/DTA/DSC)	MS-24	Quote	2007	84	84	91.0
	1L09	Materials Synthesis	NMR Spectrometer - Bruker	MS-72	Quote	2006	421	421	445.1
	1L20	Materials Synthesis	Vacuum Evaporator	MS-59	Quote	2007	68	68	73.8
	1L19	Materials Synthesis	PPMS (phys. propt. in field)	MS-60	Catalog	2006	239	239	252.4
	1L19	Materials Synthesis	Vibrating sample Magnetometer	MS-80	Quote	2007	209	209	227.3
		Materials Synthesis	Miscellaneous Equipment		Estimate	2007	61	61	66.1
		Materials Synthesis Total						**2,046.0**	**2,180.7**

E. CFN Technical Equipment Baseline

WBS	New Room #	Cluster	Equipment	Equipment Tag #	Estimate Source	FY Order Date	unit price (1000's)	total price (1000's)	Escalated Price
1.2.5	1L38	Proximal Probes	Low Energy Electron Microscope (LEEM)	PP-5	Quote	2005	912	912	938.9
	1L38	Proximal Probes	UHV, Variable Temperature, Scanning Tunneling Microscope	PP-1	Quote	2005	450	450	462.7
	1L38	Proximal Probes	UHV, Low Temperature Scanning Tunneling Microscope	PP-4	Quote	2005	645	645	663.6
	1L34	Proximal Probes	Environmental, Combination STM/AFM	PP-2	Quote	2007	155	155	168.1
	1L38	Proximal Probes	UHV Nanoprobe (Omicron)	PP-6	Quote	2006	1421	1421	1,503.7
	1L34	Proximal Probes	NSOM/SPM (Nanonics)	PP-3	Quote	2006	209	209	221.1
	1L33	Proximal Probes	Combination Optical Microscope and UltraObjective SPM Head (Accurion)	PP-7	Estimate	2007	93	93	100.9
	1L33	Proximal Probes	Raman Spectroscopy	PP-9	Estimate	2007	125	125	135.7
	1L33	Proximal Probes	UV-VIS Raman Microscope (Renishaw)	PP-10	Quote	2006	196	196	207.3
	1L33	Proximal Probes	FT-IR, FT-Raman, IR Microscope (Bruker)	PP-11	Quote	2006	242.5	242.5	256.5
	1L39	Proximal Probes	UV/VIS/NIR Spectrometer (Varian Cary 5000)	PP-13	Estimate	2007	84	84	91.2
		Proximal Probes	Miscellaneous Equipment		Estimate	2007	64.55	64.55	70.1
		Proximal Probes Total						**4,597.4**	**4,819.7**
1.2.6	2L01	Theory & Computing	Computer System	TC-1	Quote	2006	56	392	414.7
	2L01	Theory & Computing	Miscellaneous Software & Hardware	TC-1	Estimate	2007	55	55	59.7
		Theory & Computing Total						**447.0**	**474.4**
1.2.7		CFN Endstations at NSLS	165mm CCD Detector System for X-Ray Diffraction	LS-1	Quote	2006	240	240	253.9
		CFN Endstations at NSLS	Wide Angle Detector	LS-2	Estimate	2006	50	50	52.9
		CFN Endstations at NSLS	Fast Detector	LS-3	Estimate	2006	150	150	158.7
		CFN Endstations at NSLS	High Resolution GID Detector	LS-4	Estimate	2006	100	100	105.8
		CFN Endstations at NSLS	Optical Table 1	LS-5	Estimate	2006	50	50	52.9
		CFN Endstations at NSLS	Optical Table 2	LS-6	Estimate	2006	50	50	52.9
		CFN Endstations at NSLS	Flight Tube	LS-7	Estimate	2006	30	30	31.7
		CFN Endstations at NSLS	In-vacuum SAXS/GISAXS Sample Chamber	LS-8	Estimate	2006	100	100	105.8
		CFN Endstations at NSLS	Motion Control Electronics	LS-9	Estimate	2006	50	50	52.9
		CFN Endstations at NSLS	Vacuum System	LS-10	Estimate	2006	50	50	52.9
		CFN Endstations at NSLS	Miscellaneous Equipment		Estimate	2006	50	50	52.9
		CFN Endstations at NSLS Total						**920.0**	**973.2**
		Grand Total						**22,508.9**	**23,643.9**

8. PROJECT MANAGEMENT AND CHANGE CONTROL

A. Measurement

1. Scope, Cost and Schedule Performance Measurement

   a. The project scope (including technical equipment), schedule and cost baselines identified and described herein constitute the project baseline. These baselines have been evaluated and finalized at Critical Decision Two (CD-2). After approval of CD-2, the baselines shall only be changed through Section C, “Baseline Change Control Process”, below.

   b. Technical variations to the project scope that significantly alter the intended performance or deliverables will require a Baseline Change Proposal (BCP). Technical parameters and deliverables shall be monitored through the design, construction and commissioning phases of the project.

   c. Measurement of project performance shall utilize an earned value management system (EVMS) conforming to ANSI Std. E1A-748. The system shall be utilized to:

      - Establish a baseline cost loaded activity based schedule for the entire project Budgeted Cost of Work Scheduled (BCWS) organized by WBS activity.
      - Identify in monthly reports the Budgeted Cost of Work Performed (BCWP); Actual Cost of Work Performed (ACWP); schedule variance (BCWP – BCWS); and cost variance (BCWP – ACWP).
      - Provide additional analysis indicating Estimate At Completion (EAC), Estimate To Complete (ETC) and Variance At Completion (VAC).
      - Provide cost and schedule performance data in terms of $ value and time as well as percent.

B. Planning & Control

1. Planning

   a. The CFN Project Manager shall be cognizant of performance scope, schedule, and cost parameters of the facility throughout the design, procurement and construction phases.

   b. The CFN Project Manager, at regular intervals, shall compare the actual performance with the plan and provide a report monthly.

2. Contingency Management

   Any use of project contingency will be authorized through the DOE Federal Project Director. Contingency will be managed to Level III of the WBS. CFN Project Manager will report and provide justifications on the need for contingency. Monthly reporting of project contingency will be required.

C. Baseline Change Control Process

Change approval levels and thresholds listed in Table 1 below establish the levels for any changes to the project baselines. Approved Baseline Change Proposals (BCPs) will be the bases to modify the baseline. Appendix E is the Baseline Change Proposal Form for the CFN project. A change may be proposed by any project participant or stakeholder. The change advocate (if not the cognizant WBS manager, the Project Manager, the CFN Director, (or a representative of the funding agency) must find a co-sponsor. The Cost Control Manager reviews the assignment of change level, reviews the identification of affected system(s), confers with the Project Manager, if needed, and changes them, if appropriate.

Any Level 2 and above BCP will be reviewed by the project Baseline Change Control Board (BCCB) prior to submittal for approval. The BCCB will include the DOE Federal Project Director, CFN Director, CFN Project Manager (Chairperson), CFN Technical Equipment Coordinator, Conventional Construction Manager (Secretariat), ESH&Q Coordinator, and a representative from the A/E firm (if appropriate). All Level 0, Level 1, and Level 2 approved changes to the CFN building and/or technical equipment list will be transmitted for information to the BES program manager for the CFN.

To keep the project moving, it is expected that action will be taken on BCPs within two weeks at each level, more rapidly if at all possible. BNL's CFN Project Manager will communicate any approved Level 3 changes to the DOE Federal Project Director on a routine basis.

Significant changes to the technical scope of WBS 1.2 will involve significant consultation with research stakeholders from the CFN Clusters and the user community, as has been done extensively in the development and prioritization of the proposed baseline equipment list.

Directed changes can be initiated at the Secretarial Level, or Level 1. Directed changes will be communicated to the CFN Director and Project Manager, who will prepare a BCP. Upon approval, the baselines will be modified to reflect the scope, cost, and schedule impacts of the directed change.

The Project Manager is responsible for executing and documenting the approved technical scope for the overall project within the approved cost and schedule baselines. Each WBS manager is responsible for executing and documenting the approved technical scope of the WBS system, within the approved cost and schedule baselines. The Project Manager and WBS managers must use the change control process to add, subtract, or modify the approved technical baseline scope/deliverables.

The Cost Control Manager is responsible for the administrative operation and coordination of the overall baseline change control system in support of all CFN Project participants. This responsibility includes initial review and administrative processing of all CFN BCPs. This begins upon receipt of a draft BCP from the change advocate and continues through the various reviews. The Cost Control Manager is responsible for implementing approved technical, cost/budget, and schedule/milestone baseline changes in the official CFN project baseline documents and files.

Table 1

Definition of Baseline Approval Levels

	DOE Secretarial Acquisition Executive (Level 0)	DOE Acquisition Executive (Level 1)	DOE Federal Project Director (Level 2)	CFN Director (Level 3)
Technical Scope	New scope or performance not in conformance with current approved Project Data Sheet	Any change affecting CFN Mission or scope as defined in Section 3 of this document	Any addition or deletion of scope affecting CFN Building Size (# floors and square footage to within 10,000 sq ft) or any change to the Technical Equipment List	Any significant change to CFN scope as defined in approved Title I Report
Schedule	≥ 6 months (cumulative) delay in a Level 1 schedule milestone (see Table 2)	≥ 3 month delay in a Level 1 schedule milestone (see Table 2)	Any delay in a Level 1 schedule milestone or > 3 month delay in a Level 2 Milestone (see Table 2)	> 1 month delay in a Level 3 schedule milestone or >1 month delay in a Level 2 Milestone (see Table 2)
Cost	≥ $5M increase in TEC: - $79.7M TPC: - $81.0M	Any increase in TEC: - $79.7M TPC: - $81.0M	The smaller cumulative change of ≥ $300K or 50% to each WBS Level 2 Cost Element	Any change in a WBS Level 3 Cost Element

Table 2

Project Management and Control Milestones

Level and Number	Milestone Description	Completion Date
0-1	Approve Acquisition Strategy	Jul 2003 (A)
1-1	CD-0 (Approve Mission Need)	Jun 2002 (A)
1-2	CD-1 (Approve Alternative Selection and Cost Range)	Jul 2003 (A)
1-3	CD-2 (Approve Performance Baseline)	May 2004
1-4	CD-3 (Approve Start of Construction)	Dec 2004
1-5	CD-4a (Approve Start of Initial Operations)	Apr 2007
1-6	CD-4b (Approve Start of Full Operations)	Apr 2008
2-1	Complete Title II Design of Conventional Facilities	Sep 2004
2-2	Approve Technical Equipment Baseline	May 2004
2-3	Start Conventional Facilities Construction	Jun 2005
2-4	Complete Technical Design	Jul 2006
2-5	Complete ORE for Beneficial Occupancy of Building	Feb 2007
2-6	Complete Procurement	Mar 2007
2-7	Complete Installation and Testing of Technical Equipment	Mar 2008
3-1	Start Title I – Design of Conventional Facilities	Aug 2003 (A)
3-2	Award Conventional Facilities Construction Contract	Mar 2005

9. REPORTING

Cost and schedule performance will be monitored, evaluated and reported using Earned Value Process. The CFN Project Manager is responsible for the preparation of all data for reports and reviews in accordance with the appropriate project requirements identified below. Corrective actions will be included as part of the monthly performance report for any baseline variances beyond 10%.

BNL's Report to BAO

- Monthly Project Status Report
- Quarterly Project Status Report / Formal Review
  - Technical Status Narrative
  - Problems / Corrective Actions
  - Schedule Status (Baseline vs. Actual)
  - Cost Status
- Earned Value Report

BAO's Report to DOE/HQ

- Project Assessment Reporting System (PARS)
- Quarterly Report & Teleconference as needed
  - Summary Assessment
  - Critical Decision Status
  - Cost & Contingency Status
  - Schedule Summary
  - Narrative Highlights

10. QUALITY ASURANCE

Quality Assurance (QA) principles, in alignment with BNL's business practices are integrated into all aspects of the design and execution of the CFN Project. The quality assurance aspects integrated into this Plan expand on the information contained in each Lab's QA program by specifically addressing the 10 criteria of DOE Order 414.1A for this project. Compliance with these criteria ensures that QA will be achieved throughout the life of this Project and that "lessons learned" will be documented for future projects. Implementing the quality requirements contributes to improved safety, management, and the reliability of products and services.

The scope of quality assurance includes items, processes, and services required for:

- Planning.
- Building design, including consideration for long-term O&M costs.
- Construction.
- Process equipment procurement, specification, installation, acceptance, testing, and start-up.
- ES&H associated with all activities.
- Security.
- Communications and computer systems.

CFN QA objectives are to corroborate that:

- The Project Director provides planning, organization, direction, control, and support to achieve the objectives of the Project.
- The implementing user groups achieve quality and accept full accountability.
- Overall Project performance is reviewed and evaluated using a schedule driven assessment process.
- Design is adequate to meet the intended function.
- Procured items and services comply with design.
- Construction is performed as specified by design.
- Inspection and testing are performed to verify acceptability.
- Feedback and improvement considerations are continuously applied to the project.

All critical systems are subject to QA review. Typical QA processes are followed regarding design checks and approvals of the design criteria, performance specifications, Title I and II documents, and change orders. These are intended to ensure that at the end of the project, the configuration is the actual physical and functional configuration of the end product as reflected in as-built documents.

QA requirements are communicated to CFN PMT members, the Integrated Project Team, and outside contractors through this Plan, written specifications, construction documents, contract agreements, design criteria, performance specifications, and the request for quotation (RFQ).

The complete Project Quality Assurance Program (PQAP) for the project is included as Appendix D of this PEP.

11. VALUE ENGINEERING

Value Engineering is an organized effort directed at analyzing the functions of systems, equipment, facilities, services, and supplies for the purpose of achieving the essential functions at the lowest life-cycle cost consistent with required performance, reliability, quality, maintainability, environmental protection, and safety. This analysis reduces processes, equipment, facilities, services, supplies, or products to their most basic functional elements and then looks for cost efficient alternatives.

A formal value engineering review of the project will be performed during the Title I and Title II engineering phases to insure that the project technical and quality objectives are met using the most cost-effective approach. A formalized VE program will be followed using an in-house (supplemented by select A/E staff) VE team consisting of trained VE professionals. The Value Engineering requirements are provided in various references in DOE Order 430.1B, Real Property Asset Management.

12. MAINTAINABILITY AND OPERABILITY

The A/E has been directed to include project specifications that will address considerations for designing or selecting key equipment and systems to facilitate improved maintenance and operation. BNL has provided specific direction for the basis of design to require equipment and systems that are compatible with existing BNL equipment and systems. In particular, the fire alarm system and building automation systems shall be compatible with the existing site-wide BNL systems.

A full building Commissioning Plan will be prepared during Title II to assure the readiness of the individual systems before they are energized and placed in service. An independent Commissioning Agent will be brought aboard during the Title II design and will remain with the project during the installation, startup, and acceptance of mechanical and electrical systems. The Commissioning Agent will coordinate with the A/E, FPSC, CR, and PM.

The Final Commissioning Record issued by the Commissioning Agent, after verification of construction and preoperational testing are completed by FPSC, will establish the building is ready for the Operational Readiness Evaluation (ORE) team inspection. The resolution of all pre-occupancy findings in the ORE report constitutes acceptance of the building and completion of physical construction. The PM, in coordination with the CR, will assure all punch list items, i.e., minor incomplete work, incomplete documentation, outstanding or unacceptable submittals are addressed prior to the issuance of the Completion Certificate to the FSPC.

Upon final acceptance of the completed project, the following documentation of project deliverables will be turned over to Operations and Maintenance Department.

Commissioning Record
Vendor and Manufacturer Data
As-Built Documentation
Operating and Maintenance Manuals

13. INTEGRATED SAFETY MANAGEMENT

This project will be performed in accordance with BNL's approved Integrated Safety Management (ISM) Program. These requirements are delineated in the BNL Standards Based Management System (SBMS) and further detailed in the implementing policies and procedures of each BNL department or division. These policies and procedures require the following steps consistent with ISM principles:

- Review of project scope by subject matter experts (SMEs) for identification of hazards prior to design commencement to assure that engineering controls can be incorporated to mitigate chemical or other hazards wherever feasible.
- Review of completed design by SMEs to verify that hazards have been addressed and mitigated wherever feasible in the facility or experiments' design and to assure appropriate safety requirements are included in design documents.
- Selection of contractors or vendors based on their record of acceptable safety performance in addition to cost, commercial and technical qualifications.
- Application of work controls requirements that assure contractors, vendors and in-house staff are not allowed to proceed with physical work until required safety documents (Safety Plan) are approved, all necessary training is completed and all applicable permits are in place.
- Regular monitoring and inspection of project execution to assure all hazard mitigation requirements are properly carried out, and that communication processes exist as needed to review and approve any changes in work controls in response to changed conditions.
- Evaluation of project execution for feedback and continuous improvement of the safety and work controls program.
- Evaluation of contractor and vendor safety performance at project 50% and 100% completion points to provide feedback for improvement of the contractor's safety program and verify continued qualification to perform work at BNL.

14. SITE DEVELOPMENT, PERMITS, and LICENSING

The project has been reviewed under the National Environmental Policy Act (NEPA) and the evaluation concluded that the proposed project to be Categorically Excluded. The project will be located on federal property, no further permits or licensing will be required.

15. RISK MANAGEMENT

A Risk Management Plan (RMP) has been developed, and attached as Appendix C. Attachment A to the RMP is the charter for the CFN Risk Management Team. Risk anticipated for this project will be managed in accordance with the methodology identified in the DOE Manual 413.3-1, and as detailed in the updated Risk Management Plan dated May 2004. For each identified risk, mitigation strategies have been developed. The CFN Project Manager is responsible for applying this risk management methodology during the conceptual, preliminary and detailed design phases of the project as well as incorporating risk based decision processes during construction.

The Risk Management Team will evaluate and update the risk within the RMP periodically. The evaluation will include updating and documenting risk identification, risk quantification, risk handling strategies, impact determination and risk closeout.

16. SYSTEM ENGINEERING

System engineering principles will be employed by including all users and stakeholders in the development of the project from conceptual design through construction and turnover to operations.

17. SUSTAINABLE BUILDING DESIGN

This project will be designed to meet the principles of Sustainable Design. The project design team will include architectural and engineering staff trained in sustainable design, familiar with Leadership in Energy and Environmental Design (LEED) rating criteria, and recommendations of the Green Building Council. The project team will also include an environmental engineer responsible for identifying pollution prevention opportunities and a certified energy manager/energy engineer responsible for identifying energy savings opportunities and performing an energy analysis. The project design objective will be to achieve the highest LEED rating possible consistent with mission functional requirements and the established project budget.

18. TRANSITION TO OPERATIONS

The CFN building will be occupied when construction is complete and all building systems have been verified to be complete and operational. Technical equipment will be installed with project funds after the Beneficial Occupancy date. This equipment will transition to operation in support of programmatic activities upon completion of acceptance testing and readiness assessments. CD-4a (Start of Initial Operations) will be requested for the CFN building after the contractor completes final punch list items and building construction is complete. CD-4b (Start of Full Operations) will be requested when the technical equipment installation is complete and all equipment is tested and verified to meet the manufacturer's specifications.

19. ELIMINATION OF EXCESS SPACE

In the Conference Committee Report 107-258, MAKING APPROPRIATIONS FOR ENERGY AND WATER DEVELOPMENT FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 2002, AND FOR OTHER PURPOSES, Congress established the requirement for elimination of excess buildings and facilities equivalent to the square footage of each new project. The excess facility offset requirement will come from the "space bank" accumulated by BNL since 2002 through the Excess Facility Disposal Project. Excess space banked as of September 2004 will be approximately 166,000 SF. The new BNL Research Support Building (RSB) is approximately 65,000 SF and the CFN 94,500 SF. This will leave a small balance in the Excess Facility Disposal Program of approximately 6,500 SF.

Approval for all demolition is obtained through the DOE Chicago Operations Office prior to commencement of demolition activities. The Chicago Operations Office obtains the required concurrence from the General Service Administration and the Department of Housing and Urban Development prior to issuing approval. BNL receives approval from the New York State Historic Preservation Officer (SHPO) prior to demolishing any facility on site. BNL also issues the required notification of demolition activities to the Environmental Protection Agency (EPA).